**MESOPAUSE TEMPERATURE VARIATIONS:
TENDENCIES OF CHANGE
FROM OBSERVATIONS DURING LAST DECADES AND MODEL SIMULATIONS**

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Temperature variations at the mesopause (MT) T_m measured in 1960-2014 at the Zvenigorod Scientific Station (56N, 37E) of the A.M. Obukhov Institute of Atmospheric Physics RAS (ZSS IAP RAS) are analyzed in comparison with variations of global surface air temperature (GSAT) δT_{gs} [1]. Long-term simulations with the INM-CM3.0 global climate model for the 20th-21st centuries are considered as well [2].

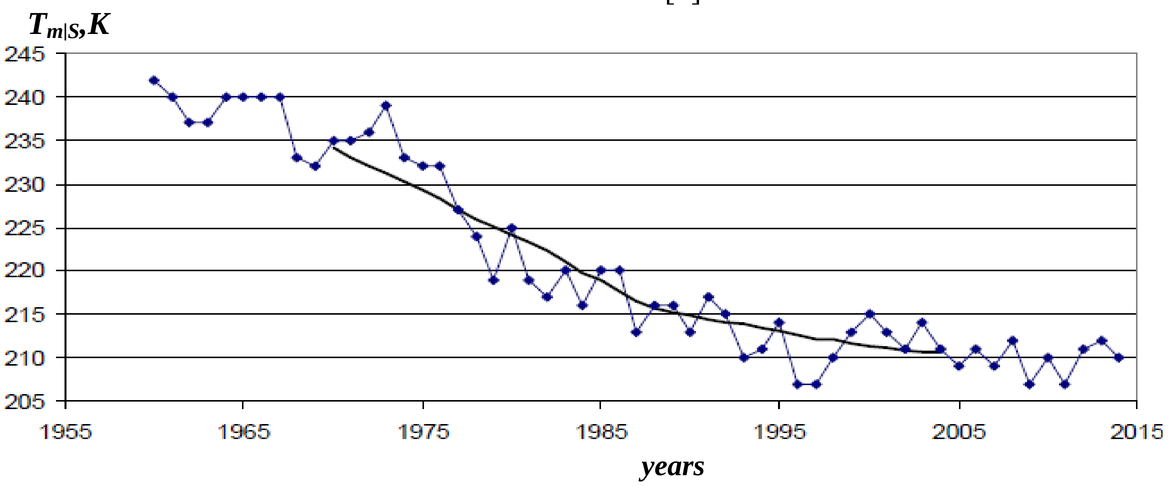

Fig. 1. The interannual $T_{m|S}$ variations (K) from winter observations at the ZSS IAP RAS during the period 1960-2014 (black curve - with 21-year moving averaging).

Figure 1 presents the interannual MT variations obtained from winter observations at the ZSS IAP RAS during the period 1960-2014; variations associated with solar activity *S* ($T_{m|S}$) are excluded. The interannual variations show a strong general decrease of Tm|S during the second half of the 20th century in winter (December-January-February) with a significant slowing of this cooling during the last decades.

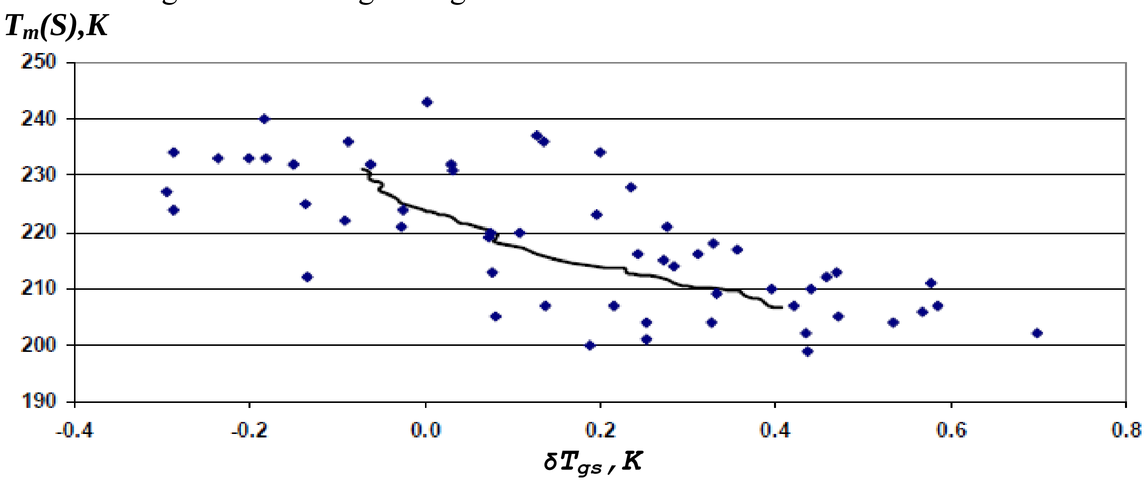

Fig. 2. The relationship between $T_m(S)$ variations from observations at the ZSS IAP RAS (K, ordinate) and variations of global surface temperature δT_{gs} (K, abscissa) in winter during the last 55 years (black curve - with 21-year moving averaging).

Figure 2 characterizes the relationship between MT variations obtained from the observations at the ZSS IAP RAS without excluding variations associated with solar $T_m(S)$ and GSAT variations (http://www.cru.uea.ac.uk/cru/data/temperature/) in winter during the last 55 years (1960-2014). A significant correlation between MT and GSAT was obtained for the whole time interval analyzed (1960-2014). There are essential differences for various decadal-scale intervals for the shorter intervals. It should be noted that the cross-wavelet analysis [3] did not reveal significant coherence of the most long-period variations in MT and GSAT for the analyzed data series. This is due to the relatively short length of the data series considered in the study.

To estimate the expected long-term coherence between MT and GSAT variations numerical simulations with global climate models can be used. Figure 3 shows the wavelet coherence between GSAT and MT (at the 0.005 hPa level) at 56N in winter found by INM-CM3.0 simulations with anthropogenic forcing according to the SRES-A2 scenario for the 21st century. Solid thin lines separate areas of edge effects, and solid thick lines bound the areas with local coherence at the 95% significance level.

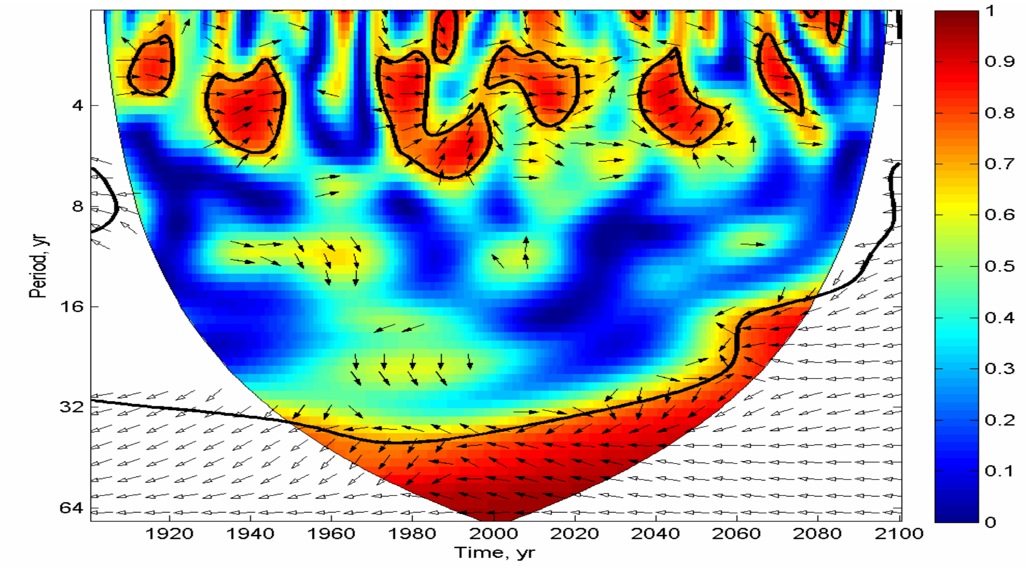

Fig. 3. Wavelet coherence between GSAT and MT (at the level 0.005 hPa) at the latitude 56N in winter from INM-CM3.0 simulations with anthropogenic scenario SRES-A2 for the 21st century.

The results of model simulations show the statistically significant negative coherence between MT and GSAT variations with periods larger than 3 decades. To display such a coherence from observations it is necessary to have at least twice longer data set for MT.

References

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